ACCIALINI CONSULTING

Agile Manufacturing

More adaptive, resilient and sustainable Manufacturing

Agile Manufacturing has been acknowledged as

the production approach of the

4th industrial revolution

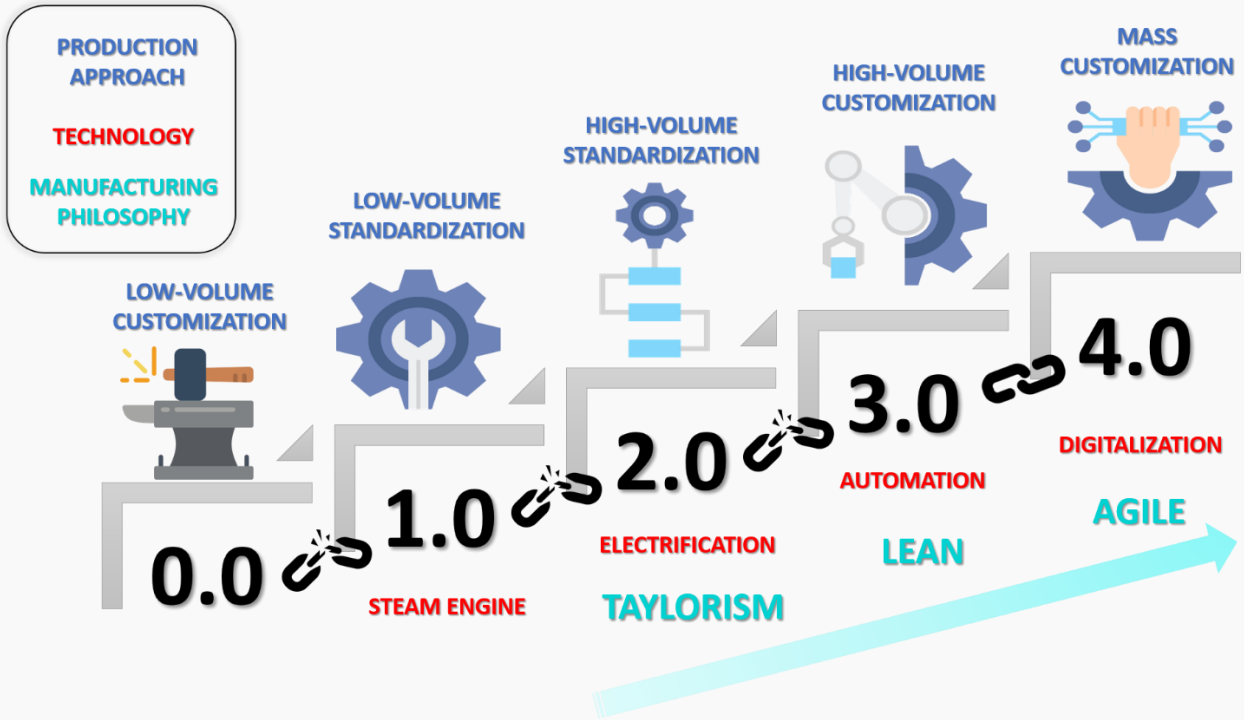


Table of Contents

What is Agile Manufacturing?

Agile Manufacturing is a manufacturing philosophy that **emphasizes flexibility, adaptability, and responsiveness in production processes**. It is an approach that allows manufacturers to quickly respond to changing market demands and customer needs.

The term Agile refers to a set of principles and practices aimed at delivering high-quality products that meet the needs of customers in a fast-changing environment.

The term **Agile Manufacturing** was first coined in the early 1990s, during a time of increasing global competition and rapidly changing market conditions. As a result, manufacturers began to explore new ways to improve their competitiveness and responsiveness to changing customer needs, leading to the development of the Agile Manufacturing strategy. In January 1991, the term appeared in an important report entitled "*21st Century Manufacturing Enterprise Strategy*" by the Iacocca Institute at Lehigh University in the United States.

The term Agile raised popularity in early 2000s when a group of software developers created the **Agile Manifesto**. This group, which included industry experts such as Kent Beck, Martin Fowler, and Ron Jeffries, sought to create a more efficient and effective way of developing software. The Agile Manifesto, published in 2001, outlined a set of guiding principles for **Agile software development**.

Over time, the **Agile approach** has been adopted and adapted by other industries, including manufacturing, where it has been used to improve production processes, reduce waste, and increase flexibility. Today, Agile principles and practices are widely used across many industries, including software development, product development, manufacturing, and project management.

Definitions of Agile Manufacturing

Over the years, several definitions of Agile Manufacturing have been provided[1]:

- **Iacocca**: "*Agility means a production system with extraordinary capabilities to meet the rapidly changing needs of the market (speed, flexibility, customers, competitors, suppliers, infrastructure, responsiveness). A system that moves quickly (speed and reactivity) between product models or product lines (flexibility), ideally in response to customer demand in real time (customer needs and wishes)*"
- **Goldman**: "*Agility is a global strategic response to the fundamental and irreversible changes that are occurring in the dominant system of commercial competition in the "First World" economy*"
- **Booth**: "*Agile manufacturing is a manufacturing vision that is a natural development of the original 'lean manufacturing' concept. In lean manufacturing, the emphasis is on cost reduction. The need for organizations and structures to become more flexible and responsive to customers has led to the concept of "agile" production as a differentiation from the "lean" organization*"
- **Yusuf, Sarhadi**: "Agility is the successful exploration of competitive foundations (speed, flexibility, innovation, proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to deliver products and customer-oriented services in a rapidly changing market environment"

[1] Esmail, K., and Saggu, J., 1996, "A changing paradigm". Manufacturing Engineer, December 1996, p285-288.

VUCA and Agile Manufacturing

VUCA and Agile Manufacturing are two concepts that are related to each other in the business world, particularly in the context of manufacturing.

VUCA is an acronym that stands for **Volatility, Uncertainty, Complexity, and Ambiguity**. It refers to the rapidly changing and unpredictable business environment that many organizations face today. The VUCA concept was first introduced in the 1990s by the US military to describe the challenges of the post-Cold War world.

Agile Manufacturing, on the other hand, is a set of principles and practices that allow organizations to respond quickly and efficiently to changes in the business environment. It emphasizes flexibility, adaptability, and collaboration in manufacturing processes.

Agile Manufacturing is a response to the challenges of the VUCA environment. The rapid pace of change and uncertainty in the business world requires organizations to be able to quickly adapt and respond to new challenges and opportunities. Agile Manufacturing provides a framework for doing so, by emphasizing the importance of flexibility, collaboration, and continuous improvement.

Why we need Agile Manufacturing

"The definition of insanity is always doing the same thing, but expecting different results"

Albert Einstein

Agile Manufacturing means being able to **offer a greater production mix using fewer resources**. At the time of writing this whitepaper, many manufacturing companies are facing a tough crisis that is putting them under pressure. On the one hand, the Covid-19 pandemic had substantially blocked the production lines both for the prevention measures adopted to limit the spread of the virus and for the problems of supplying raw materials and components in general. Additionally, the current international instability is making the situation even worse with an increase in inflation and rising prices of energy resources never seen before.

As a result, companies are faced with important choices if they want to survive and remain competitive in the global market. However, crises also mean **opportunities** for those who know how to seize them.

Among these opportunities**, reshoring**, i.e., the choice of reallocating production sites in the countries of origin, is certainly one of them. In fact, globalization has encouraged companies to build or move their factories in developing countries to take advantage of new emerging markets and especially low labor cost. Bringing manufacturing back home means not only shortening and bringing the supply chain closer, making it more resilient to macroeconomic phenomena, but above all it means a substantial paradigm shift in the production approach.

The relocation of activities and companies has been an important strategic issue in developed economies in recent decades. However, today reshoring is arousing increasing interest since more and more activities of returning to their country of origin

(back shoring) or to a neighboring country (nearshoring) within OECD countries are reported.

Also, **there is no certainty that reshoring will lead to an increase in jobs**: rather, reshoring involves additional capital investments in the country of origin but also in neighboring countries. Due to these extra investments, for example in robotics and automation, the expectation is that relocated manufacturing will only create a limited number of additional jobs and that these jobs will be increasingly highly skilled.

The same conclusion is reported in a more recent publication by Professor Klaus Schwab, chairman and founder of the World Economic Forum. In his book "*The fourth industrial revolution*", he explained how the data confirm this trend: greater technological investments but not a proportional increase in the workforce.

In November 2011, the German government had launched the **Industrie 4.0 high-tech initiative**, with the aim of revitalizing the manufacturing sector particularly affected by the financial crisis of 2006. Industrie 4.0 is based on the use of a series of technologies, mostly digital, to increase the flexibility and productivity of manufacturing systems, while improving quality and reducing associated costs at the same time. A trend that the pandemic data has helped to accelerate.

What's next?

In May 2020, Professor Olivier De Weck from Massachusetts Institute of Technology held a webinar entitled "*Future of Manufacturing*". In this webinar, Professor De Weck cites a survey in which the following question has been asked to different research groups within the institute: "*What are the prospects for manufacturing in the United States? Where are we headed?*"

The first consideration reinforces what has been previously stated, namely that none of the new emerging technologies will generate a large number of new jobs, but nevertheless the new jobs generated will require a higher level of skills. In addition, respondents were asked to indicate which emerging technologies with the greatest

impact on manufacturing would be for the next 5-10 years. Below are the 5 technologies that obtained the highest consensus among respondents:

1. **Smart Automation**, i.e., systems that enable automation (e.g., Robots) but also equipped with hardware and software for the exchange and processing of digital information (cyber-physical systems, or CPS)
2. **Precision Manufacturing**, that is all those technologies that increase precision and reduce variability within industrial processes, from machining to assembly
3. **Lightweight materials**, that is, the development of materials capable of maintaining high mechanical properties, but at the same time reducing their specific density and therefore weight
4. **Information technologies for manufacturing**, that is, all ERP (Enterprise Resource Planning), MES (Manufacturing Execution System) and PLM (Product Lifecycle Management) systems that manage the information flow within the technical offices and the workshop
5. **Advanced sensors**, that is the development of sensors capable of interconnecting the various cyber-physical systems underlying the Internet of Things (or IoT)

In another webinar held in full pandemic in January 2021, the German consulting firm Roland Berger presented some data on the impact of Covid-19 in aerospace manufacturing, one of the most affected sectors, but also a strategy to react as quickly as possible to the crisis. The question in this case was: "*How to make aerospace manufacturing ready for the post-Covid future?*". Roland Berger shows the way in 5 fundamental points:

1. **Flexible Manufacturing**: companies will have to rethink their adaptive approach, i.e., they will have to make their products more resilient and flexible through a greater level of:
   a. agility, that is to reconfigure their production systems quickly
   b. scalability, that is to increase or reduce production volumes rapidly
   c. digitalization, to maximize the added value generated by data exchange
   d. automation, to reduce dependence on manual labor

e. use of new technology, including additive manufacturing, Augmented Reality (AR), Virtual Reality (VR), autonomous robotics (i.e., Cobots and AGVs)

2. **Adapt the industrial footprint**, which means making the supply network more resilient through:
   a. flexible factories in strategic regions, for example with small and flexible assembly lines close to key customers and an inventory capable of coping with temporary material shortages
   b. a supply chain close to the assembly line, creating a Just-in-Time (JIT) system with local suppliers
   c. integration of suppliers in cost-competitive countries, through the integration of IT solutions and real-time monitoring in production
3. **Sustainable production**, that is, companies that do not integrate environmental sustainability into their processes will face many problems towards their customers in the future. Solutions will therefore have to be found in different areas of the production chain:
   a. supply chain, for example by selecting responsible suppliers and limiting CO2 emissions by creating a network of local suppliers
   b. energy consumption, by creating increasingly efficient and low energy impact processes
   c. production processes, by using processes with low environmental impact
4. **Design for Manufacturing**, that is, product and process design must be increasingly integrated and cohesive through cross-functional design and organization processes
5. **Diversification**: in the aerospace field, for example, companies will need to create synergies by leveraging businesses and markets with similar technological capabilities and solutions, such as wind, electric mobility, fuel cells and medical technology

The scenarios described so far only lead to one conclusion: developed countries must **regain possession of the manufacturing know-how** evidently neglected due to globalization, focusing on producing better, faster and at lower costs.

Indeed, **relocation essentially means a competitive advantage in terms of labor costs**, as it is clearly not possible to pay workers the same wages and keep goods at very low prices in developed countries. Bringing manufacturing back home would mean either significantly raising prices for the end user, or reducing workers' wages.

However, there is a third way: **developing agile manufacturing systems**.

The 3 pillars of Agile Manufacturing

In short, **an agile manufacturing system is capable of reconfiguring itself quickly according to the production mix and market demands, with high-level autonomy**.

Such a system would employ less direct labor (therefore fewer recurring costs), but greater use of highly skilled workers in the design and implementation of agile systems.

An agile manufacturing system is also able to produce higher quality goods, by virtue of the high repetitiveness of the process guaranteed by technology, in particular by automation, in less time and with an extremely high level of customization. Produce better, with fewer resources.

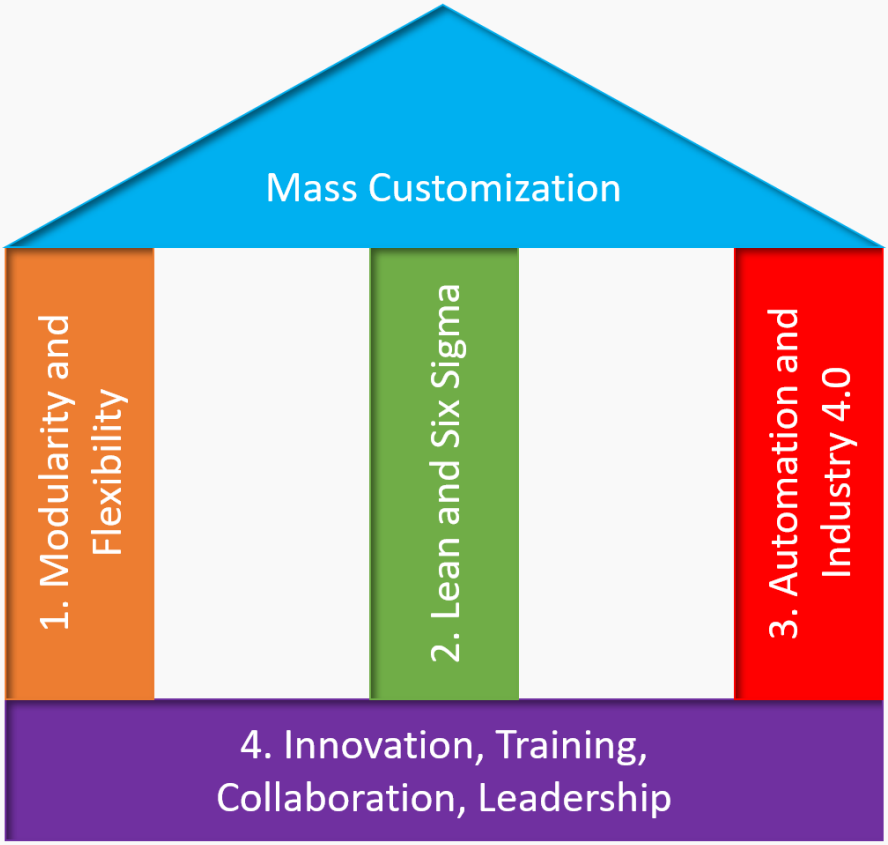
The 3 pillars of an agile manufacturing system are:

1. **Design modularity and reconfigurability** - this implies the design of **modular and flexible products and production systems**, for example through simultaneous engineering, product platforms and the implementation of smart setups
2. **Design of lean and robust systems**: agile manufacturing is based on **Lean Manufacturing principles** and tools to minimize waste, as well as on methodologies for improving process capabilities such as **Six Sigma**
3. **Use of automation and 4.0 technologies**: automation and digitalization are the founding technologies of manufacturing agility. Thanks to automation, it is possible to improve efficiency, quality and reduce production costs, while digitalization helps to improve the exchange of information and real-time analysis, thus make the system more flexible and resilient.

These 3 pillars must be built on solid foundations, consisting of **an innovative approach** when it comes to introducing new solutions, approaches and methodologies.

However, there can be no innovation without a **culture of change**, which requires the ability to face and manage risks and seize opportunities from external (socio-political) and internal (organizational) changes. Finally, agility certainly requires an innovative

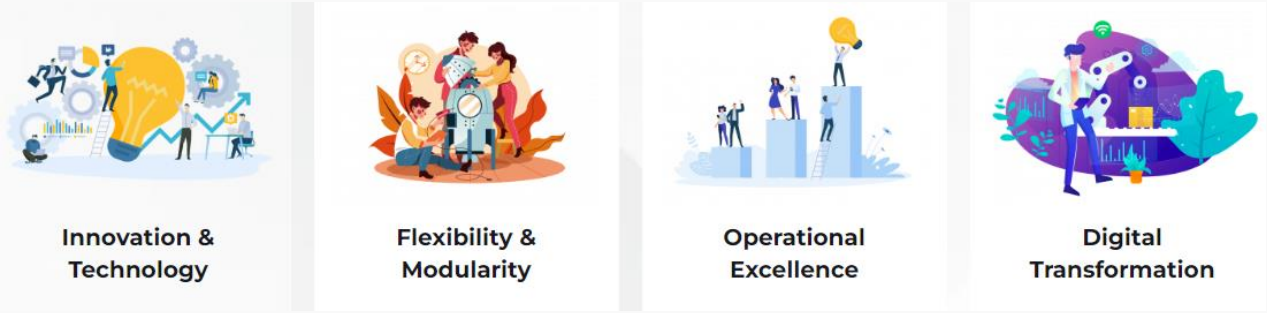
approach and consequently a series of both **hard and soft skills will have to be implemented and properly managed**. Agility will require a vision and methodological guidance that only **strong and cohesive leadership** can provide.



How to enable Agile Manufacturing?

At **Accialini Consulting**, we will provide you with the proper support!

Thanks to our partners, we focus on all specific areas to develop agile manufacturing roadmap:



If you want to start your agile manufacturing journey, we have a well-defined and structured approach:

1. Agility Assessment

How Agile is your Manufacturing Method? We help you to assess your agility level with our Agility Assessment Tool

2. Agility Gaps

Discover your weaknesses and fill in the gaps to implement a more Agile Manufacturing System

3. Agile Roadmap

Take actions! We help you to identify pilot projects and to implement an Agile Manufacturing Roadmap

For more info, don't hesitate to contact us!

Accialini Consulting

Calle Lugo 13, 2B – 18100 Armilla (Spain)

Mobile: +34 623195453

Email: nicola@accialiniconsulting.com

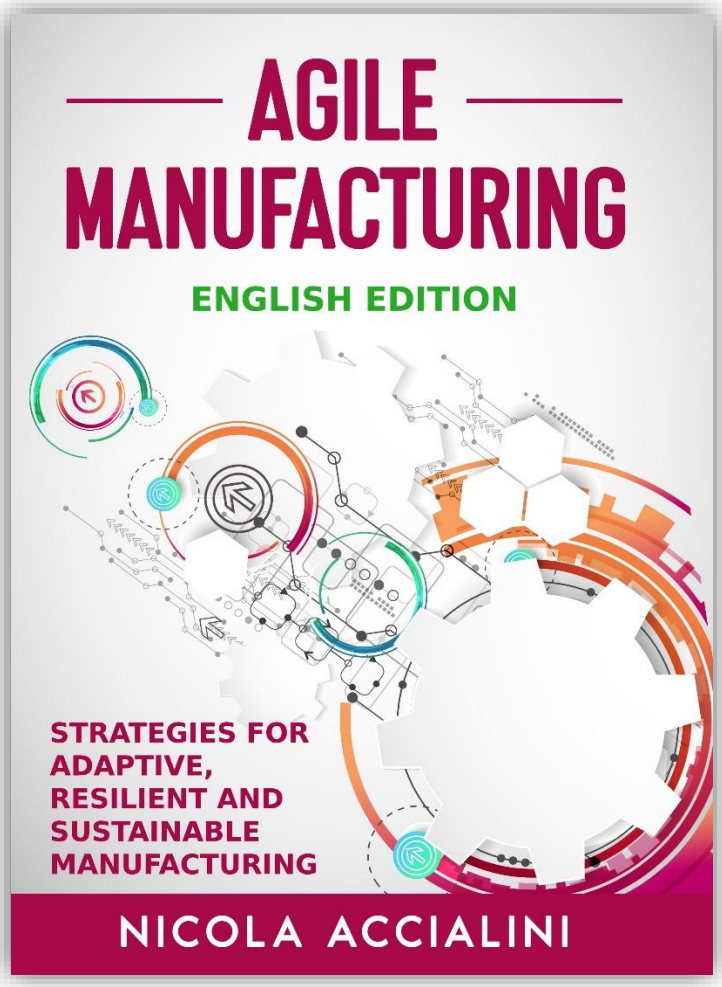
About the Author

Nicola Accialini is an Aerospace Engineer. After graduating from the University of Padua, he worked for some of the leading aerospace companies in international contexts.
In his professional career, he has managed projects related to the development of new products and the implementation of new production technologies that in 2016 led him to take an interest in the world of Industry 4.0 and the Smart Factory.
Since June 2019 he has been living and working in Spain as an Agile Manufacturing Coach and he supports companies in product and process innovation processes in the manufacturing sector.

Nicola Accialini

Agile Manufacturing Coach

The Book



Order now at amazon.com

https://www.amazon.com/dp/B0BNTXG4TD

YOUR AGILE MANUFACTURING CONSULTANT

www.accialiniconsulting.com